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Department of Agriculture

ANNUAL REPORT

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DEPARTMENT OF AGRICULTURE.

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DEPARTMENT OF AGRICULTURE.

Annual Report for the year 1936.

AGRICULTURE IN THE TERRITORY.

In a country in which no one has yet experienced a normal season, the word "abnormal" is hardly an adequate description of the season which has just passed. The opening rains were late and a prolonged drought in the latter part of January and in February fully justified the consternation it caused. A dramatic change then took place for the late rains were copious and extended well into April. Had these rains been delayed for a further week the result would have been disastrous, but they came just in time to save the summer cereals which responded amazingly. The gloomy forebodings that the newly established Maize Control Board would have nothing to control gave place to relief that the Board had been established in time to deal with a record crop. While they saved maize and kaffir corn growers, the late rains were responsible for poor crops of wheat and tobacco. The situation of the preceding year was thus completely reversed.

Maize.

2. It is usually held that maize planted in the new year has little chance of setting a crop. Nevertheless the lateness of the opening rains caused planting to continue until the middle of January. The condition of the late planted crops appeared almost hopeless at the end of February but they came through and yielded abundantly. European maize production is illustrated by the following table.

3. MAIZE PRODUCTION.							
	<i>Kalomo</i>	<i>Maza- buka</i>	<i>Lusaka</i>	<i>Chi- samba</i>	<i>Fort Jame- son</i>	<i>Other Dis- tricts</i>	<i>Total</i>
1935-36—							
Acres planted ...	1,011	13,541	17,355	8,067	62	1,167	41,203
Yield in bags ...	6,916	114,518	121,721	78,862	454	6,182	328,653
Yield per acre ...	6.8	8.5	7.0	9.8	7.3	5.3	8.0
1934-35—							
Acres planted ...	864	12,054	17,181	8,817	100	1,002	40,018
Yield in bags ...	2,079	53,345	43,979	58,039	564	2,368	160,374
Yield per acre ...	2.4	4.4	2.6	6.6	5.6	2.4	4.0
<i>Increase (+) or De- crease (—) in</i>							
1935-36—							
Acres planted ...	+147	+1,487	+174	—750	—38	+165	+1,185
Yield in bags ...	+4,837	+61,173	+77,742	+20,823	—110	+3,814	+168,279
Yield per acre ...	+4.4	+4.1	+4.4	+3.2	+1.7	+2.9	+4.0

4. The yield of 8 bags per acre is 1.1 bags in excess of the previous record and, by any standard, must be considered satisfactory. The majority of the better growers obtained upwards of 10 bags per acre. 274,000 bags of farm grown maize were surrendered to the Maize Control Board. No figures for native production are available but again the harvest was exceptionally heavy and 150,000 bags had been acquired by the Board by the end of the year.

5. Comparison of farm grown maize yields obtained in recent years is of interest.

<i>Year</i>	<i>Bags per acre.</i>
1919-30 (<i>Average yield</i>) ...	... 4.6
1930-31 ...	... 4.5
1931-32 ...	... 6.9
1932-33 ...	... 3.6
1933-34 ...	... 6.9
1934-35 ...	... 4.0
1935-36 ...	... 8.0

The years 1932-33 and 1934-35 would have been bad enough in any case, but the yields were further depressed by severe locust damage. In the strangely alternating good seasons, when locust damage could have been better afforded, the crops were unscathed.

6. Having exasperated and impoverished maize growers season after season, Fortune has at last made amends. The timely introduction of Maize Control stabilised internal prices at a reasonable level and created machinery for the export of the surplus. In its first year the Control Board was faced with the task of disposing of an accumulation equivalent to the internal requirements of $2\frac{1}{2}$ years. For the first time in farming history in Northern Rhodesia, world price became the dominant factor and, through a strange combination of circumstances, the world price of flat white maize soared to the late 1929 levels. The sudden rise in price alone brought fully £30,000 into the Territory.

Maize Control.

7. Maize Control came into operation on the 1st May. I was chairman of the Control Board until the end of the year but have since handed over to the Treasurer on his return from leave. It would be improper to anticipate the Board's report which will be published at the end of the pool year, but some indications of the direct and indirect effects of maize control on native agriculture are not out of place here.

8. One of the most obvious conclusions from the first year's working is that hitherto only a small fraction of the native crop has been sold in years of plenty. In providing a cash market for all surplus maize, control has been of the utmost value to native growers, but there have been a number of repercussions. Ploughing has increased considerably (this can hardly be regarded as a healthy development at the present time) and there is a tendency to crowd in toward the railway line. With the jingling of coins in his unaccustomed ear, the native has become hard of hearing if not deaf to offers for his cattle, and cotton growing, which formerly offered the sole assured opportunity of earning cash, has lost some of its attraction. The new wealth may make labour farm scarce and more expensive. These repercussions were not unanticipated and, while they may cause temporary difficulties, satisfactory adjustment to the new conditions should ultimately be possible. The need for better methods is accentuated but simultaneously the inducement to adopt better methods has been provided. The attitude of the native grower to maize control is perhaps best expressed by the following quotation from a letter published in *Mutende*: "This is a blessed year!"

Wheat.

9. The season was a disastrous one for wheat growers. The humidity caused by the late rains produced conditions which favoured the spread of rust. The crop suffered heavily and a large proportion of the acreage sown produced nothing. 4,249 acres were planted, an increase of more than 1,000 over the acreage of the previous year, but the total crop reaped was only 11,121 bags, a decrease of 7,107 bags. Roughly 10,000 bags were offered for sale.

Kaffir Corn.

10. Kaffir corn growers shared the good fortune of maize growers. Crops were exceptionally abundant and a shortage in the Union of South Africa afforded a ready market for the considerable surplus over local requirements. There was a net export of 22,000 bags as compared with a net import of 3,000 bags in the previous year. Kaffir corn growing is almost exclusively in native hands. It is to be hoped that the unexpected good fortune of the past year will not encourage over-production. Profitable export will only recur by chance and the crop, being far more perishable than maize, does not store well.

Tobacco : Fort Jameson.

11. Climatically, the season was unfavourable. The rainfall was badly distributed and insufficient until the end of January, while in February and March, when drier conditions are desired, rain was almost incessant. These conditions inevitably reduced the quality of the crop, but they at least provided a demonstration of the value of good planting methods. Where seed beds had been sprayed and the plants well primed, reasonably satisfactory crops were obtained ; where these precautions were neglected disease was rife and many fields had to be totally abandoned.

12. Disposal of the crop proved less difficult than usual. A larger quantity was sold locally for cash. A three day auction sale at which 200,000 lbs of leaf, mostly of the lower grades, was sold, was a godsend to many planters, but it is hoped that the shipment of this leaf will not injure the reputation of the district. Happily most of it was bought to fill definite orders. The export figures of packed tobacco were :

United Kingdom	...	...	581,000 lbs
Union of South Africa	...	...	350,000 lbs
Southern Rhodesia	...	...	155,000 lbs.

Practically no tobacco worthy of the name remained on hand at the end of the season.

13. The formerly common practice of cropping land to the point of exhaustion is rapidly giving way to rotational farming. Green manuring has been taken up on the majority of the large estates and these now show a ratio of 1 acre of green manure to 3 acres of tobacco, which is probably as much as can be recommended. Fertiliser sales have increased considerably. 91 tons were used during the past season and although this only works out at about 60 lbs per acre over the whole district, for some planters still will not or cannot fertilise, it represents a substantial advance on former practice.

Tobacco : Western Area.

14. With the clamour of maize farmers for alternative crops it is somewhat surprising that tobacco production on the railway line should have declined. The area is allotted a share of the Union quota amounting to 50,000 lbs and is thus far assured of a profitable market, yet production in the past year was little more than sufficient to fill the quota. While one would hesitate to suggest, at this stage, that more barns should be built, there are several estates which already possess the necessary buildings but which have abandoned tobacco growing. Where conditions are suitable, resumption of planting on a modest scale could hardly fail to be profitable.

15. The department is unable to extend to the railway belt the services it provides for Fort Jameson planters, and it has been represented that more interest would be taken if advice were more readily available. As an experiment, Government has now agreed to pay half the salary of a Secretary-Grader for the Northern Rhodesia Tobacco Co-operative Society on condition that the advisory services of the employee shall be available to all tobacco planters in the western area.

14. VIRGINIA TOBACCO (FLUE CURED).

					<i>Railway Belt</i>	<i>Fort Jameson</i>	<i>Total</i>
1935-36—							
Acres planted	...	...	...	...	129	3,127	3,256
Yield in pounds	...	...	...	...	52,000	1,149,000	1,201,000
Yield per acre	...	...	...	...	403	367	369
1934-35—							
Acres planted	...	...	...	...	160	3,218	3,378
Yield in pounds	...	...	...	...	76,000	1,480,000	1,556,000
Yield per acre	...	...	...	...	475	460	461
<i>Increase (+) or Decrease (—) in 1935-36—</i>							
Acres planted	...	...	...	...	—31	—91	—122
Yield in pounds	...	...	...	...	—24,000	—331,000	—355,000
Yield per acre	...	...	...	...	—72	—93	—92

In addition 60,000 lbs of sun cured Virginia leaf were produced at Fort Jameson and 13,000 lbs of Turkish leaf in the Kalomo district.

Coffee.

17. At Abercorn, coffee planters had a bad year. The early part of the season was fairly promising but towards the end of the rains there was a good deal of die-back and many trees were unable to ripen the crop they carried. It seems probable that this was a sequel to the heavy crop of the former year—a typical example of biennial bearing. It also points to the necessity for keeping trees in good condition.

18. For some years coffee planting has stagnated. A few plantations, which never would have proved very satisfactory, have been abandoned and the loss in acreage has been made good by extensions of other estates. The infant industry has thereby gained in health but not in stature; it is still only equivalent to four or five medium sized estates. Without new settlers and new capital it may be doubted whether there will be much further progress. A few newcomers with sufficient capital to establish estates of 70 to 80 acres on what are now believed to be the right lines are badly needed. There can be no degree of certainty in any agricultural enterprise, but while the value of coffee on the estate remains above 6d. per lb, a good coffee plantation at Abercorn should be reasonably profitable.

19. While little progress has been made in extending the industry, the planters have taken very active steps to make the most of what already exists. A co-operative society, supported by all planters, has recently been formed to deal with the marketing of the entire crop. A small factory will be established at Abercorn from which the internal market will be supplied with roasted and ground coffee in tins. The surplus over local requirements will be exported and it is intended to put only the top grades on the London market.

Agricultural Imports.

20. Early in the year the Agricultural Advisory Board sub-committee on agricultural imports issued its report which, with a few minor amendments, was adopted by the Board and subsequently by Government. The report showed that the popular idea that imports of agricultural produce connoted lack of enterprise was erroneous and was unwarranted reflection on our producers. Careful analysis of the customs returns (Class I) showed that the partly avoidable agricultural imports amounted to only one quarter of the total and that only one half of the partly avoidable items was really avoidable. It was estimated that if local production entirely replaced avoidable imports the resulting *gross* return would not exceed £30,000 per annum. Net profit would, of course, be but a fraction of this figure. The comparative insignificance of this additional market will be realised when it is stated that the gross return from established maize production alone is between £100,000 and £150,000.

21. Small though it may be, no opportunity of supplying our own markets should be neglected. It is estimated that the local market can absorb an additional 5,000 bags of shelled groundnuts, 10,000 bags of beans and 10,000 bags of wheat, and the sub-committee made definite recommendations on the action which should be taken to increase production of these crops. It is not proposed to recapitulate the published report here, but it should be mentioned that the immediate effect of the adoption of the sub-committee's groundnut and bean scheme has been to replace 3,000 bags of imports by local products. The scheme came into operation in April so this is simply a measure of the progress made in disposing of crops which would otherwise have been largely unsold. The full effect will not be realised until 1937 when more produce should be available as a result of the stimulus given to planting. The adoption of the wheat scheme has secured for at least two years a fair market for all the wheat we are likely to produce.

Agricultural Exports.

22. For some years the volume of agricultural exports has remained at an almost negligible figure. Exports of unmanufactured tobacco, which have been fairly constant at about £40,000 per annum, have been of far greater importance than the combined exports of other products. During 1936, however, full use was made of the opportunity provided by the combination of exceptionally favourable export conditions and abundant crops. The following table gives the values of exports of

tobacco and other agricultural (excluding pastoral) produce of local origin in recent years.

				<i>Tobacco</i>				<i>Other produce</i>
				£				£
1932	...	...	...	39,000	...	...	...	9,000
1933	...	...	...	35,000	...	...	...	17,000
1934	...	...	...	42,000	...	...	...	4,000
1935	...	...	...	43,000	...	...	...	7,000
1936	...	...	...	38,000	...	...	...	90,000

The notable increase in exports during 1936 was due, almost entirely, to maize and kaffir corn.

Locusts.

23. Red Locusts had practically disappeared in Northern Rhodesia by the end of 1935. In January 1936, a number of gravid swarms entered the Petauke district from the south, and in February it was found that a swarm of great size was laying over a wide area in the Luano valley.

24. With a few unimportant exceptions, the season's breeding was restricted to the south-east corner of the Territory bounded by Lat. 14 S and Long. 29 E. This area includes the greater part of the Luano and lower Luangwa valleys. Within these limits breeding took place on a large scale, and it was reported that in April hoppers were continuous over a front of 30 miles in the Luangwa valley. Disease and parasitism, which almost annihilated hoppers of the previous generation, were curiously inactive and caused but little mortality among the bands.

25. Hoppers matured during May, and in June young swarms from the Luano and lower Luangwa valleys began a definite migration towards the west and north-west. This migration was augmented by an influx of swarms from Portuguese East Africa into the Petauke district. During August swarms spread to the extreme northern and western limits of the Territory.

26. A further invasion took place in September when numerous swarms appeared from the Zambezi valley and moved in a westerly direction through the Mazabuka district. During October swarms were sufficiently numerous in the north-west to cause some anxiety. By the end of the year, however, the position had improved considerably, though a number of swarms, which had commenced egg-laying, still menaced the main farming area.

27. A small swarm of Tropical Migratory Locusts was observed near Kasempa in October. There were no other reports on this species.

WORK OF THE DEPARTMENT.

28. 1936 saw the appointment of an additional Agricultural Officer. Lest this bald statement should fail to convey its true significance, it should be added that this is the first new appointment since 1930, and reference should also be made to the table which appears in paragraph 76 of this report. This small increase in staff has enabled a much needed agricultural station to be opened near Pemba.

29. Exclusive of headquarters, there are now three agricultural stations at which extension work is, or will be, in progress. There are also three Agricultural Officers. There is no provision for casualties, nor can adequate arrangements be made for the relief of officers on leave. The need for continuity will become more and more marked as extension work proceeds and, however badly agricultural stations may be needed in other parts of the Territory, consolidation of the progress already made must come first. The next new appointment cannot be posted to a Province but must act as an itinerant relief to the three existing stations.

30. Forestry continued to be administered as a sub-department. The year's work is recorded at length in Part II of this report.

The Ecological Survey.

31. The report on the Ecological Survey of North Western Rhodesia, which had repeatedly been delayed by incidence of leave and sickness, has at last been completed and is now in the press. The Survey is now being extended to North Eastern Rhodesia.

32. During the absence of the Ecologist on sick leave, Mr. Clothier, the Agricultural Officer of the Survey, undertook an investigation of Native Reserves II and IV in the Fort Jameson district. It was well known that the consequences of local overcrowding in these reserves were becoming serious, but it was thought advisable to obtain a complete picture of the situation before submitting a programme of action. The detailed report, supported by soil and population maps, showed that while overcrowding has in parts caused situations which are beyond redemption by solely agricultural means, ample fertile land exists though action is required to make it habitable.

33. In both Reserves there are two main soil classes—granite sands and chocolate or red loams. The granite sands are comparatively well-watered and do not erode badly, but they can only support shifting cultivation. In most parts they are being worked too long. More frequently shifts would avoid the killing of tree stumps and thus enable cultivated areas to recover more rapidly. The loams are capable of permanent or semi-permanent cultivation, some indeed possess remarkable fertility, but large stretches have no surface water whatever and are 'fly' infested, and all are liable to severe erosion.

34. The situation is further complicated by the broken nature of parts of the country. Where the population is dense many of the once-fertile valleys have been exhausted by over-cropping and erosion, and the villagers have taken to the cultivation of incredibly steep hill gardens. This has given them temporary relief but only at the cost of permanent damage to the land below. In these circumstances propaganda against hill clearing would be futile and an embargo would be grossly unfair unless alternative sites were offered.

35. In both Reserves, particularly in Reserve II where the situation is most serious, there exist large tracts of waterless, 'fly' infested but fertile land which could readily support the excess population of the congested areas, if the tracts can be rendered habitable. The first need is to investigate the possibility of providing water. If adequate water can be provided it is thought that there would be a voluntary migration, at least of people who, living near the present 'fly' line, have already lost most of their cattle. It is possible that the occupation of strategic points may lead to a retreat of 'fly' and render possible the keeping of cattle in the reclaimed areas. Expert advice on the water and fly problems is being sought.

36. In general, it is evident that the problem of these reserves can only be solved by administrative cum agricultural action. The same may be said of the majority of agricultural problems in this Territory where the cash incentive to better farming is not as prominent as it is elsewhere. The controlled migration of a large portion of the population is a vast administrative task; the role of the agricultural department is clearly to advise the administration as to the way in which the migration can be accomplished without hardship and, indeed, with benefit to the native cultivators. Before giving advice the department must be absolutely sure of its ground. Funds were therefore requested for the establishment of two small substations at which methods of working the granite sand and loam soils respectively were to be investigated. Unfortunately it has not yet been possible to provide these funds.

37. The task of putting these reserves in order is an enormous one, but it must be faced for the population cannot exist indefinitely under the present conditions. It may be that expert advice will show that the uninhabited areas cannot be rendered habitable, in which case more land must be provided elsewhere. The provision of funds for agricultural extension work in the more congested areas would be futile until the fundamental remedy of removing the excess population has been applied. Not only is it too much to expect a native cultivator to work harder merely in the hope that his children and grandchildren may live in the same place, but, even if it were possible to enforce improved methods, there would still be insufficient land to enable the worst areas to support their population in perpetuity. This is not an exaggeration. In the south east of Reserve II the population averages 135 per square mile. The soils are not remarkably fertile and the greater part of the area, being extremely hilly, should not be cultivated at all. Again, some tracts of poor granite sand are at present carrying a population of 100 to the square mile with the result that this country, which is entirely dependent on tree growth for what little fertility it possesses, is now almost completely deforested.

Cotton in Native Areas.

38. The results of the preliminary trials of cotton in native areas and the principles which determined the selection of areas for trial were outlined in the last report. These trials were repeated on a considerably larger scale in the Mazabuka, Kalomo, Mumbwa and Namwala districts and, on a smaller scale, were extended to the Livingstone and Mongu-Lealui districts.

39. Every area suffered from late opening rains and unfavourable planting conditions, consequently germination was frequently poor and much of the crop was late planted.

(a) *Reserve XI: Pemba.* (Transitional bush.)

Late planting in conjunction with severe frosts in late May and a generally poor standard of cultivation adversely affected yields. At our instigation many plots were sited in old gardens in order to find whether a profitable crop could be produced from land abandoned for maize. On such land weed competition proved too much for the plants and yields were invariably poor. The highest yield for the area was 260 lbs and the mean was 179 lbs seed cotton per acre.

(b) *Kalomo.* (Plateau soils of *Brachystegia* woodland.)

In this area, also, planting was late and early frosts destroyed much of the late crop but yields were unexpectedly good, the highest being 506 lbs while the mean was 257 lbs per acre. It is fortunate that cotton can be grown so satisfactorily on these soils as they are ill-adapted to commercial maize growing.

(c) *Mumbwa.* (Plateau soils of the *Brachystegia-Isobertina* woodland.)

Here again the crop was adversely affected by late planting, poor cultivation and early frost. One plot yielded 234 lbs and the mean was 176 lbs per acre. A disquieting feature of the Mumbwa trials is that for two seasons the cotton has been somewhat inferior in staple to that grown elsewhere.

(d) *Namwala.* (Transitional Kalahari Sands.)

Late planting was followed by a very serious attack of giant cricket (*Brachytrypes membranaceus*) which completely destroyed the majority of the plots and, as it was too late to replant, the trials were a failure. The appearance of the giant cricket as a serious pest at Namwala is an unexpected setback. It may be possible to evade damage by early planting but, if not, there is little likelihood of further progress in this area.

(e) *Livingstone.* (Kalahari Sands.)

The majority of the trial plots were planted on the loose deep sand soils characteristic of this area. Two plots were situated on the more compact transitional sands which contain a high proportion of fine sand. On the loose sand types the crop was a complete failure. The plots on transitional sands yielded 164 and 135 lbs per acre respectively. Cultivation of these plots was exceedingly poor; at harvest they were completely hidden in a dense growth of *Kalaharia spinescens* which made complete picking impossible. In the circumstances the yields are surprisingly good.

(f) *Mongu-Lealui.* (Kalahari Sands.)

The trials in the Mongu-Lealui district confirmed the Livingstone district results. It is evident that cotton cannot be grown on the loose sand soils carrying open *Burkea* and *Baikiaea* bush types. All the plots were on soils of this type and, for all practical purposes, they were complete failures. Weather conditions were not abnormally severe and the standard of cultivation was sufficiently high. The failure of the crop was most probably due to inability of the soil to retain sufficient moisture and to the excessively high surface temperatures developed during drought periods. On these loose sands the temperatures were sufficiently high to cause necrosis of stems of young plants at ground level.

40. The failure of the trials on the looser types of Kalahari sand is a disappointment as it rules out a considerable portion of North Western Rhodesia. The remoteness of the central Barotse Province would have reduced the local value of seed cotton to little over $\frac{1}{2}d.$ per lb, but as there is no other prospect of a cash crop it was thought that even at this level cotton might be attractive, and the concentration of

population made a trial worth while. Unfortunately it has now been proved conclusively that cotton will not grow on the greater portion of the land available. Messrs. Allen and Bebbington toured the Mongu-Lealui, Kalabo and Senanga districts and found that there were areas of 'Mutemwa' sand and certain manured gardens which offered some hope, but these were so restricted that it was decided to concentrate, in the first instance, on the railway belt regions in which prospects are much more favourable.

41. The existence of an agricultural station at Fort Jameson made it possible to initiate preliminary trials in the Luangwa Valley, where the population is dense and conditions appear to resemble those of parts of Nyasaland where cotton growing has become an established industry. This area, again, is on the economic border line, but there are no competing cash crops.

Prospects of Cotton Growing.

42. The trials in several different types of country made in this and preceding years have shown that the former limiting factor, stainer damage, can be evaded to a considerable extent by confining cotton growing to areas carrying certain well-defined vegetational types. This at least is true while the areas under cotton remain relatively small. Widespread cultivation might possibly upset the stainer-wild host relationship, but it is unlikely that cotton growing will ever spread to this extent. In many respects the 1936 trials were disappointingly conclusive, but the fact remains that over a period of three somewhat unfavourable seasons certain districts have produced native-grown crops equal in yield to those of the majority of African cotton growing territories. Moreover the yields might well have been doubled had the plots been better cultivated.

43. While the world price of the crop remains above 6½d. per lb there seems to be no reason why cotton should not be more profitable than maize on Transitional soils within reasonable distance of the railway line. A moderate cotton crop should bring in a return of 16s. to £1 per acre; only in the most exceptional circumstances would the native maize crop of a district yield even the lower of these returns.

44. Unfortunately the native does not see things in this light. The recent introduction of Maize Control has afforded a cash market for maize, and it seems probable that one bag of maize (200 lbs) will usually be worth more than one bag of seed cotton (48 lbs). If it were possible to get sufficient seed cotton into a bag to enable the bag price to be advanced beyond that of maize, cotton would have an immediate appeal it lacks to-day. There are also other considerations. It is only sound common sense on the part of the native cultivator to concentrate on planting his food crops before turning to a crop which can only be sold, but his innate shrewdness reduces his cotton yields, for cotton should be planted as early as possible. He will give his maize crop an early cultivation before bothering about young cotton in which clean weeding in the seedling stage is even more necessary. Cotton also requires more careful planting and harvesting.

45. On the other side of the picture there are the factors that cotton will grow on soils which are incapable of producing a commercial maize crop, it will stand higher transport charges and it has definite rotational value. The first two factors should render the crop attractive in the less fertile and more remote areas; realisation of the third should, in time, overcome the unreasoning attitude of commercial maize growers in the matter of bag value.

46. Progress will inevitably be slow and if a cotton growing industry is ultimately established it will be trivial in comparison with the size of the industries in most of the African territories. It would none the less be a factor of great importance in the economic life of the native of Northern Rhodesia, for here, where we can never aspire to agricultural greatness, small developments have a peculiar value. There can be no doubt that an attempt to establish an industry is well worth while and it is not unreasonably optimistic to feel confident of some measure of success.

47. Despite the prejudices which experience will probably overcome; cotton growing is passing beyond the experimental stage at Pemba and Mumbwa. Here the critical period has been reached and the next two or three years should see the

success or failure of the project. The following table shows the number of growers in various areas of the Southern Province since the trials were started.

Area	Number of Growers		
	1934-35	1935-36	1936-37
Pemba	4	30	100
Mumbwa	4	11	74
Kalomo	4	11	14
Namwala	3	10	10
Livingstone ...	—	14	—
Sianjalika	—	—	7
	—	—	—
	15	76	205
	==	==	==

Advice on Irrigation.

48. An agricultural department of a size that Northern Rhodesia can afford, cannot possibly cater for the entire needs of the farmers. Advice in specialised matters can be provided more economically by the temporary employment of specialists, than by their incorporation in the permanent staff. Accordingly, a definite need for advice on irrigation projects was met, during the year, by the secondment of Mr. J. Savory, an Irrigation Engineer of the Southern Rhodesian Agricultural Department.

49. Wheat is one of the few crops which offer scope for increase production by European farmers and expansion is limited by the amount of irrigable land available. It was thought that costly mistakes might be avoided and that more use might be made of existing irrigation works if expert advice were available. Mr. Savory's secondment was fully justified and he was of great assistance to the twenty farmers he visited. My appreciation of the courtesy of the Southern Rhodesian Government in seconding Mr. Savory for a period of six weeks and of the excellent work he accomplished in the time, is gratefully recorded.

50. Mr. Savory's investigation of the Chisamba irrigation projects is of particular interest. In this area, unlike Lusaka where limestone springs are used, the source of supply is the natural water-table held in gravelly beds. It is to be expected that the table will fall as the schemes are developed, and the supply of irrigable water may ultimately fail altogether. The cost of the schemes is, however, so low that they will have paid for themselves before this happens, if happen it does. One of the drawbacks to reliance on the natural water-table is that, on most farms, the only lands sufficiently low to be irrigable are found in black vleis which will require a good deal of treatment before they will yield satisfactory wheat crops. Where better soil could be irrigated good crops have already been obtained.

Publications.

51. Mr. Trapnell's paper *Ecological Methods in the Study of Native Agriculture in Northern Rhodesia* was published in the Kew Bulletin of Miscellaneous Information No. 1 of 1937. Messrs. Allen and Bebbington contributed a paper entitled *The food cycle of Dysdercus fasciatus in Acacia Savannah* to the Bulletin of Entomological Research, July 1936.

THE MAZABUKA STATION.

52. The Mazabuka station serves as headquarters for the Agricultural, Veterinary and European Education departments and, as far as this report is concerned, as a site for detailed cotton investigations. In the latter respect the station has probably reached the limit of its usefulness and it would now seem advisable to transfer the investigations to those areas in which cotton is likely to become a commercial crop. As the Mazabuka experiments are financed by the Empire Cotton Growing Corporation, a decision on this matter has been deferred pending a visit by the Corporation's advisers.

Cotton at Mazabuka.

53. No formal experiments were made during the year. The work on the station was limited to observations on various strains of U4, and to detailed work on stainer and bollworm. Records of the fluctuation of stainer populations in the field, with particular reference to *D. superstitiosus* were continued, and complementary nutrition and development studies were made in the insectary. The results were in agreement with the previous findings on the relation between the host sequence of stainers and the attack on cotton.

54. American bollworm egg counts were made on maize, sorghum, groundnuts and native beans with the object of testing their efficiency as trap crops. Laying on maize increased steadily to a peak as the plants came into tassel, while on the other crops it was irregular and there was no definite laying peak. The number of eggs laid on the different maize plantings was from four to twenty times greater than that on cotton. There was no significant difference between layings on cotton, sorghum, groundnuts and beans.

55. The attack both of stainer and bollworm was comparatively light and good rains in March and April enabled the plants to mature a late crop. Thus, in spite of unfavourable conditions in the early part of the season, the yields obtained at Mazabuka were unusually good.

THE ABERCORN STATIONS.

56. The Agricultural Officer was absent on leave for six months of the year and no departmental relief could be provided. The coffee station and the new native agricultural station (Lunzua) were left in charge of native assistants under the general supervision of the District Commissioner. A local planter, Mr. Howard, kindly arranged to pick and prepare the coffee crop and I am indebted to Mr. Porritt of Senga Hill Mission for the harvesting and weighing of the experimental plots at Lunzua. But for this efficient outside assistance the year's work would have been wasted at both stations.

Coffee: Manurial Trial.

57. In 1932 a block of land was stake planted with coffee to provide material for a manurial trial. An even stand was obtained and in 1935 a randomized block lay-out with eight replications was adopted to test the following treatments:

- (1) Control—No treatment.
- (2) Permanent cover crop.
- (3) Permanent cover crop plus 10 tons Compost per acre.
- (4) Vegetable mulch.
- (5) Vegetable mulch plus 10 tons Compost per acre.
- (6) 10 tons Compost per acre.
- (7) 10 tons Compost plus 150 lbs Nicifos No. 3. per acre.
- (8) 20 tons Compost per acre.

The block has now been under the various treatments for two years and the following observations are of interest, though no definite conclusions can yet be formed:

(a) The two mulched series are markedly superior in vegetative growth and leafiness to the unmulched series. The trees remained dark green throughout the season and produced thicker main stems, longer primaries and more numerous secondaries. The latter made handling necessary. There was little difference between the 'mulched' and 'mulched plus compost' plots until the fruit set, when the latter carried a much heavier crop.

(b) The two 'compost alone' series did not show the vegetative growth of the mulched plots but each set a good crop, especially those plots receiving 20 tons of compost. There was some tendency to yellowing but no sign of die-back.

(c) The two 'cover crop' series are easily distinguished by the yellowness of their leaves. The 'cover crop and compost' plots are carrying a fair crop but it is doubtful whether it will ripen. Die-back is already apparent in the 'cover crop alone' plots.

(d) The 'compost plus Nicifos' plots are remarkable. The trees are dark green and fairly well grown but the crop carried is out of all proportion to their size. It seems that Nicifos has promoted the setting of fruit at the expense of vegetative growth. There is no sign of die-back. The subsequent behaviour of this series will be particularly interesting.

(e) The control plots have made fair growth and have set a good crop, but die-back is becoming apparent and it seems probable that the trees will suffer next season.

58. Until the experiment has proceeded further, speculation as to the most economic treatment would be pointless but it may be mentioned here that mulching (which should be an annual operation) costs 18s. 6d. per acre, the making and application of 10 tons of compost costs £2 10s. 0d. and a 150-lb. dressing of Nicifos £3 per acre. It will probably prove unnecessary to compost and fertilise coffee every year, but it seems probable that the cost even of annual treatment would be more than covered by the increase in yield.

The Native Station : Lunzua.

59. A full description of the objects of this station was given in last year's report. The first year was devoted largely to development. Roads were made as far as funds permitted and a rest house and temporary labourers' quarters were built. As soon as funds are available a permanent house will be built for the Agricultural Officer who will then move his headquarters from Abercorn.

60. A uniformity trial with Male (*Eleusine coracana*) as a test crop indicated the most suitable sites for the experimental treatments which were begun at the end of the year. As some indication of the response of Male to applications of compost was needed as soon as possible, a small scale trial was made apart from the main experimental area. It was found that a moderate dressing of compost increased yields by one-third and this result, combined with the knowledge that excellent crops of Male have been obtained from composted land at Senga Hill Mission, leads to the hope that composting may be successfully incorporated in the "Mambwe" system of cultivation.

61. An encouraging feature of the year has been the genuine interest taken by Administrative Officers and Missionaries in this, the first serious attempt to improve the native agriculture of the Awemba plateau. For example, an appeal made in November for seed of different varieties of Male, met with such a ready response that ninety named samples reached the Agricultural Officer in time for planting in December. Neither has native interest been lacking. The main path to the south passes close by and the station has become a recognised night stop. A small wattle and daub building has been put aside for travellers and it is intended later to erect permanent rest houses.

62. A preliminary survey in anticipation of the village settlement scheme has been made and the sites for eight villages have been chosen. Their forest areas will be demarcated in 1937 and, if all goes well, the first settlers will be at liberty to move in during the following year.

THE FORT JAMESON STATION.

63. Work at Fort Jameson has hitherto been confined to tobacco, partly because it was essential that the first Agricultural Officer to be posted to the district should gain an intimate knowledge of the crop as soon as possible, and partly because in recent years no funds have been available for branching out in other directions.

64. But for the initiation of cotton trials in the Luangwa Valley, we have marked time at Fort Jameson during the past year. An abundance of urgent work is presented by the peculiar and difficult problems of native agriculture of the district, but nothing can be done until funds are forthcoming. Indeed, as has been explained earlier in this report, agricultural work on the major problem will be almost futile unless it is undertaken as part of a large scheme in which administrative action is essential.

65. Tobacco variety trials of *White Stem Orinoco*, *Yellow Mammoth* and *Bonanza* showed the last to be significantly inferior in yield. There was little to choose between the two former, though *Yellow Mammoth* gave a higher proportion of "brights". This variety, however, lacks the texture of *White Stem Orinoco* which is indisputably the best variety which has yet been introduced to the district. It would seem pointless to continue these formal trials until new varieties of outstanding merit are forthcoming.

66. Within the *White Stem Orinoco* variety some selection work has been done and two locally selected strains were compared with one imported from Southern Rhodesia. There was no significant difference in yield, but the Southern Rhodesian strain gave a slightly higher proportion of the better grades.

67. The rotation trials, which were initiated in 1931 to provide data on the effect of varying frequencies of green manuring on yield and quality of tobacco, have completed their first cycle without, it is feared, providing all the information which was expected of them, though certain points are clearly demonstrated. The rotations are :

- A. Tobacco. (f) : Sunnhemp.
- B. Tobacco. (f) : Tobacco. (f) : Sunnhemp.
- C. Tobacco. (f) : Tobacco. (f) : Tobacco. (f) : Sunnhemp.
- D. Tobacco. : Tobacco. : Tobacco : Sunnhemp.
- E. Tobacco. (f) : continuous.
- F. Tobacco. (f) : Tobacco. (f) : Pigeon pea. : Pigeon pea.

(f) = fertilised with 120 lbs Nyasa No. 4 per acre.

The series leaves much to be desired in the matter of completeness but it was feared that further additions would make the trial too complicated—a fear which subsequent experience fully justified.

68. Presentation of the complete results would occupy too much space in this report but the yields in pounds per acre, without reference to grades, are summarized below.

Rotation				Year				
				1931-32	1932-33	1933-34	1934-35	1935-36
A	...	...	...	822	SH	716	SH	526
B	...	...	...	826	536	SH	656	498
C	...	...	...	877	530	507	SH	494
D	...	...	...	791	566	431	SH	450
E	...	...	...	780	625	507	485	410
F	...	...	...	825	512	P.P.	P.P.	525

SH = Sunnhemp.

P.P. = Pigeon pea.

69. The bad season during the critical year 1935-36, when all rotations came into tobacco, almost certainly masked differences due to treatments. Statistical analysis showed that the final yields of rotations A, B, C, and F were significantly greater than those of E. Rotations A and F were also significantly superior to D. In an experiment of this nature, however, more can be learnt from observation.

70. Observations made throughout the duration of the experiment and simultaneously on the tobacco grown in another field under a rotation tobacco (f) : tobacco (f) : green manure : maize, lead to the following conclusions :

- (a) Tobacco should not appear in a rotation more than twice in succession.
- (b) Both fertilising and green manuring are essential in a rotation. A green manure once in four years should be sufficient, but each tobacco crop should be fertilised.
- (c) But for its susceptibility to eel-worm, Pigeon pea is a satisfactory green manure. It is probably unnecessary to let it stand for two years.

THE PEMBA STATION.

71. Provision of staff and funds for the establishment of a native agricultural station in the railway belt was made in the 1936 estimates. The need for such a station has been recognised for some years and it has been accentuated by the stimulus to production caused by the establishment of Maize Control. For the time being, at least, the Reserves bordering the railway line form the only region in which native agriculture may be conducted as a business as distinct from a means of subsistence, and in attempting to adapt his farming to the production of crops for sale the native has forsaken his sound traditional methods for a parody of the extensive maize farming practised by Europeans. More land is ploughed (and usually inefficiently ploughed) than can be adequately cultivated. The native has not been able to solve the problem of weeding large acreages—a problem which did not arise when he was content with sound hoe cultivation. Where he has attempted to maintain the fertility of his soil with kraal manure this has merely accentuated the weed problem. Finally the demand for large gardens has led to ploughing of land which should have remained unbroken. The solution of his problems lies in “ Better crops from smaller acreages.”

72. The site for the new station was chosen after a careful survey of the Plateau portion of Reserve XI. It lies just within the Reserve boundary and close to the village of Chief Siamauudu. This chief is a progressive man who has co-operated with the department for some years over cotton trials. The station contains two soils typical of the district—a moderately fertile red loam which is prized as maize land but very liable to erosion, and ‘Londe’ sands which are used for shifting cultivation. Authority to start work was received in September and, by working at high pressure, sufficient buildings to house the staff had been erected before the rains and a small experimental area was established.

73. The main functions of the station are to demonstrate the prevention of erosion, to develop a sound and acceptable rotation incorporating the cash crops maize, cotton, groundnuts and beans, and to attempt to introduce a simple composting system. Until experience has been gained in these matters at the station, little extension work will be attempted other than that required for the development of the cotton growing industry, which has already been started. The station will also provide a site for detailed investigations on cotton and may later serve as a seed farm.

LEGISLATION.

74. The Tobacco Marketing and Levy Ordinance was enacted in May. The Ordinance is a threefold one. It provides for the restriction of exports of flue cured tobacco to the visible and anticipated market in the United Kingdom. (This portion was included to implement an agreement made between the two Rhodesias and Nyasaland at the Salisbury Conference in 1935.) Secondly, the Ordinance makes provision for the administration of the Union of South Africa Tobacco Quota and finally, subject to request by the majority of planters, it authorises the imposition of a levy not exceeding 6d. per lb on leaf tobacco exported from an area.

75. The industry is divided into the Eastern and Western Areas and in each area a Tobacco Board has been appointed. The duties of the Boards in their respective areas are the issue of licences for export to the United Kingdom, and the allocation to planters of shares of the Union Quota.

REVENUE AND EXPENDITURE.

76. The expenditure of the department, exclusive of Forestry and the Ecological Survey, but including the entire administrative charges, has been roughly as follows in recent years :

	1931-32.	1932-33.	1933 (a)	1934.	1935.	1936.
Administrative and Clerical	£3,800	£3,300	£2,100	£1,500	£1,500	£1,500
<i>European officers employed</i>	6	6	3	2	2	2
Field Work	£17,000	£14,300	£7,400	£3,000	£4,000	£5,000
<i>European officers employed</i>	15	14	11	3	3	4
Total	£20,800	£17,600	£9,500	£4,500	£5,500	£6,500
<i>Total European officers employed</i>	<u>21</u>	<u>20</u>	<u>14</u>	<u>5</u>	<u>5</u>	<u>6</u>

(a) Estimate based on whole year.

77. Revenue is naturally small. In 1936 £300 was received from the sale of agricultural produce, and a contribution of £450 towards the cost of the cotton experiments was made by the Empire Cotton Growing Corporation. In addition, the Corporation again seconded one of their officers for work in the Territory. Their continued assistance is most gratefully acknowledged.

78. The net cost of the department was somewhat less than £6,000.

PART II.—FORESTRY.

INTRODUCTION.

79. In last year's report attention was drawn to three factors which seriously hampered this department in its work of conserving the forest resources of the Territory. These were the sharing of timber royalties, the extensive rights to timber held by mining companies and the existence of long-term and unsatisfactory timber

concessions which were granted before the establishment of a forest service. During the year under review one of these obstacles has been removed. The other two remain, but it has been possible to mitigate their effect in some slight degree.

Sharing of Royalties.

80. Under an agreement made in 1923 between the British South Africa Company (the former administration) and the Northern Rhodesia Government, revenue from land sales was to be shared equally until 1965. It was later held that timber royalty was included in revenue from land sales. A division of royalty in a territory where almost the entire proceeds from the sale of timber are necessary to secure perpetuation of the mostly convenient situated timber resources, must clearly result either in exhaustion of the forests or in their rehabilitation partly at the expense of the taxpayer, who has received no direct benefit from their exploitation. These considerations were represented to the British South Africa Company, and the Company agreed to waive its claim to a share of Timber Royalty with effect from the 1st January, 1935.

Mining Rights.

81. Under the Mining Proclamation (1912) the mining companies collectively have been able to acquire surface rights over an area of some 250 square miles by "certificate of special registration" for a mere fraction of the royalty value of the standing timber. Freehold surface rights were also granted very cheaply over an additional area of 250 square miles. In each case the taking of timber is a surface right. Thus no appreciable revenue can be obtained from an area approximately 500 square miles of forest. An even more serious aspect of the matter is that the rights are not held subject to the observance of felling and protection rules, thus Forest Officers are powerless to prevent wasteful management. The areas in question are among the most valuable of the forests in the Territory by virtue both of their quality and of their position. Even if the mining industry is not completely dependent on them, their preservation and conservative management is of the utmost importance to the mines. Until quite recently this was not fully appreciated by the mining companies. Exploitation was haphazard and wasteful and nothing was done to prevent unauthorised cutting. The warnings and advice of the Forest Officers have not been idle for they were effective in changing the situation completely during the year. The companies are now fully alive to the value of their forest assets; they are adopting simple felling rules suggested by this department, unauthorised felling is being checked, squatters have been evicted, and one company has started a thorough enumeration survey of its forest assets.

Existing Concessions.

82. The concessions under which the *Baikiaea* forests of the Livingstone District have been exploited, were granted before a forest service was in existence. The rentals were far too low to yield sufficient funds for the rehabilitation of the forests and the absence of satisfactory felling rules has rendered re-forestation unnecessarily expensive. The lessees, however, have now agreed to observe certain simple regulations in the area they are now exploiting. Felling operations have been supervised by forest guards during the year and, thanks to the co-operation of the lessees, there is marked improvement in the state in which exploited areas are being left.

The Future.

83. The lessons of the past have been bitter enough. Everything that could be done to improve matters has been attempted with some success, but the main effects of past mistakes are unalterable. The same opportunities for making the most valuable of the forests an asset rather than a liability will not recur, but every attempt must be made to safeguard areas at present free from vested rights. In particular, interaction of forestry and mining will have to be most carefully considered before the new Mining Ordinance is introduced.

84. After protracted negotiation, an agreement is about to be signed whereby some 300 sq. miles of pure *Baikiaea* forest in Barotseland will be leased to the Zambesi Sawmills Ltd., for a period of 10 years. The terms of the new lease represent a distinct advance on those of its predecessors, though it has still not been possible to negotiate an adequate rate of royalty. The proceeds from exploitation accrue not to the Government but to the Barotse nation, but a substantial portion of the proceeds will be used to create a fund from which the operations necessary for the preservation of the best of the forests will be financed. This again is a welcome innovation. Hitherto none of the money received from exploitation has been earmarked for the conservation of the forests.

ESTABLISHMENT AND ORGANISATION.

85. Last year it was found necessary to abolish the Central Division with headquarters at Lusaka and to extend the Northern and Southern Divisions to include the areas north and south of the Kafue River respectively. This arrangement is unquestionably the most efficient while the staff remains at its present level. The staff is concentrated at the two main centres of activity (the Copperbelt in the north and the *Baikiaea* forests in the south) where it is most needed. One of the two Assistant Conservators of the Northern Division also supervises the Forest Reserves and timber cutting round the two minor consumption centres of Broken Hill and Lusaka. Little supervision is required between Livingstone and Kafue as the small consumption is met mainly from privately owned land.

86. The European staff was posted as follows :

J. D. Martin, Assistant Conservator : Southern Division, January—December.

C. E. Duff, Assistant Conservator : Northern Division, January—September : Utilization Course and local leave South Africa, October—December.

R. G. Miller, Assistant Conservator : On leave January—April ; Northern Division, May—December.

G. R. Martyn, Forester : Southern Division, January—December.

87. The native staff consisted of 12 Forest Guards in the Northern and 17 in the Southern Division. In addition 15 guards were employed in the unexploited forests of Barotseland and were paid from the Barotse Forest Fund.

88. The welcome increase in native staff in the Northern Division enabled operations to be expanded and resulted in a closer supervision of exploitation. Forest Guards stationed at Lusaka, Broken Hill, Nkana, Mufulira, worked directly under the District Commissioners. On the whole this arrangement worked well, thanks to the interest taken by the several District Commissioners.

89. Towards the end of the year the creation of a higher grade for native employees was sanctioned. The men on this grade will be termed " Forest Rangers " and will, in common with the trained native staff of other technical departments, be grouped in Class I of the Native Civil Service. Hitherto it has been impossible to attract and retain educated men on the scale of pay authorised for Forest Guards. It will take some years to build up a satisfactory native staff, but now that inducement can be offered to entrants the main obstacle has been removed.

DEMARCATIION OF FOREST RESERVES.

90. Two demarcated forests were gazetted during the year. These were :

Miengwe Forest Reserve.—23,100 acres of forest on the railway line containing a large proportion of good timber species. The best parts of this area could be made to produce such timbers as *Pterocarpus angolensis* and *Entandrophragma* *sp.*, while on the poorer soils the forest will provide rougher mining timber from the *Brachystegia*—*Isoberlinia* types.

Mindolo Forest Reserve.—A fuel-wood area of 3,200 acres close to the new township of Kitwe, at Nkana Mine.

91. Proposals for four other demarcated forests were submitted before the end of the year. Three of these are fuel-wood reserves for the townships at Broken Hill, Mufulira and a proposed native town near Ndola ; the fourth covers one of the few possible sites for Eucalypt plantations on the Copperbelt.

DIVISIONAL OPERATIONS : SOUTHERN DIVISION.

92. The Division contains the important *Baikiaea* forests, which lie on Kalahari Sand formations in the Western Livingstone and Upper Sesheke districts.

The Livingstone district contains the following forests :

(a) Crown Land. (120 square miles.)

Livingstone North.—60 square miles of unexploited *Baikiaea*—*Copaifera* woodland.

Bombwe.—8 square miles. Exploited.

Katombora.—10 square miles. Exploited.

Malawe.—18 square miles. Unexploited.

Natchetwe.—10 square miles. Unexploited. (Together with *Malawe* this forms the belt known as the " Cattle Cordon Forests.")

Sala and Fuluwa.—14 square miles not yet exploitable. These forests lie in the Tunga Game Reserve.

- (b) Native Reserve. (66 square miles.)
Siburu.—26 square miles. Exploited.
Malanda.—30 square miles. Exploited.
Mapanda.—10 square miles. Exploited and now worthless.
 (c) Yeta's Forests. (104 square miles.)

The Paramount Chief of Barotseland holds long recognised rights over these forests although they lie outside the borders of Barotseland. All revenues derived from them accrue to the Paramount Chief. In contrast with the Native Reserve and most of the Crown Land forests, Yeta's forests are of very high quality. They comprise :

- Situmpa*.—38 square miles. Three quarters has been exploited.
Naluama.—14 square miles. Exploited.
Luangula.—12 square miles. Exploited.
Lonze.—40 square miles. Half has been exploited.

93. In the Upper Sesheke district lie some 300 square miles of good quality *Baikiaea* forest, of which the more accessible will probably be exploited within the next ten to fifteen years. The forests are the property of the Barotse nation.

94. The Forests Ordinance is only applicable to the Crown Land Forests. The remainder rely for their protection on laws passed by the Native Authorities. With some guidance a satisfactory series of laws has now been passed both by the Livingstone and the Sesheke native authorities and, particularly in the latter district, they have been enforced with remarkable success by forest indunas appointed by the authorities.

Reconnaissance.

95. Two hundred miles of compass and cycle traverse were made by the Assistant Conservator in the lower Machili and Sichifula flood plains in order to study the line for a logging railway to tap the Sesheke forests. A reconnaissance of the uninhabited and unmapped country comprising the Machili, Njoka and Luampa watershed was made, involving 320 miles of compass and cycle traverse. This area was found to include 60 square miles of first quality *Baikiaea* forest but the distance from the logging railhead will probably prohibit exploitation, at least for the present. With both reconnaissances the traverses were tied into fixed points and maps on the scale 1 : 250,000 were made.

96. A flight was made over the Kalahari Sand country between the Kafue Hook and Mulobezi, the logging railhead. Several areas of *Baikiaea* were identified and roughly mapped from the air for subsequent visit on foot. With the exception of this region, reconnaissance of all areas containing accessible *Baikiaea* forest has now been completed.

Enumeration Surveys.

97. An enumeration strip survey was carried out in *Siburu* Forest which was exploited from 1927–30. The average number of trees nearing exploitable size was only 5 per acre. Old unsound trees which may be useful as seed bearers averaged 1 per acre. Regeneration was almost entirely absent. Fortunately this forest is not typical. The lines are being kept open to enable a study of natural regeneration to be made. If satisfactory regeneration is not obtained within a reasonable time the forest will be abandoned. In the meantime it will be protected as it occupies an important position in any scheme of future exploitation.

98. Much more promising results are being obtained from a strip survey of 30 square miles of *Situmpa* forest exploited between 1931 and 1934. Enumeration is not yet complete but the pole growth stocking is satisfactory and regeneration abundant.

99. Eighteen miles of lines have been cut in the unexploited *Baikiaea*—*Copaifera* woodland near Livingstone preparatory to an enumeration of this type.

Silviculture and Regeneration.

100. When the Assistant Conservator was first stationed in the *Baikiaea* forests in 1931, a series of silvicultural experiments were established. These have served their purpose in showing that while creeper cutting and the girdling of interfering weed species (e.g. *Pterocarpus Stevensonii*) have undoubtedly a beneficial effect, they are much too expensive to be incorporated in a working plan.

Spot sowing, although not suitable for forests with a very dense undergrowth, proved successful in the more open areas, but again the cost is out of all proportion to the return from the forests. It is now evident that the future of the *Baikiaea* forests depends almost entirely on the prevention of irreparable damage by fire and on natural regeneration.

101. Even so simplified, the cost of management would exceed the return from the forests if complete fire protection were aimed at. Where, as in most instances, the unit of fire protection has to be the whole forest, it is reasonably certain that sooner or later most areas will suffer some fire damage. Particular attention has therefore been paid to the effect of fire on regeneration. It has been found from numerous observations that once the seedlings have developed their peculiarly deep taproot, they will shoot again even when burnt back to groundlevel. The same, of course, applies to seedlings broken and trampled during exploitation. It is clearly necessary, therefore, to keep fire out of unregenerated forests for at least two years after a seed year, and to obtain regeneration in the unexploited forests for as long as possible before exploitation takes place.

102. The vast quantity of branchwood and slash left in the forests after exploitation is responsible for the destructiveness of the fires which break out in the exploited forests, and presents a problem which has not yet been solved. Systematic burning of all slash by either the exploiting company or the department would be prohibitively expensive. The co-operation of the company has been secured in the carrying out of such measures as are possible. All slash and branchwood lying within 75 feet of the extraction lines is now stacked and burnt under supervision, and after felling all slash is cleared within 6 feet of living trees.

Fire Protection.

103. In the Sesheke District the local forest organisation, inaugurated last year, worked admirably. Control was tentatively delegated to the Native Authorities with most encouraging success. The Forest Indunas under a Head Forest Induna were made responsible for the fire protection of some 250 square miles of exploitable forest. Each Induna was able to seize the right time for burning fire guards in his own area, and therefore managed with much less labour than would have been necessary had the forests to be protected in turn by an itinerant departmental labour force. There were only three fires within the protected forests and damage was restricted to $2\frac{1}{2}$ square miles of forest, or 1% of the total protected area. In each instance the fires were extinguished by the local people and the culprits were detected and fined by the Native Authority. Fairly close supervision by the Assistant Conservator was necessary in this the first season, but the success of the experiment inspires the hope that supervision may gradually be relaxed and that fire protection by Native Authorities will become a routine operation.

104. The large areas of *Baikiaea*—*Copaifera coleosperma*—*Pterocarpus angolensis* woodland to the west of the Zambesi are the source from which most of the local canoes and paddles are obtained, and they suffer annually from severe late fires. In order to give these forests some measure of protection, the Native Authorities issued an order that early burning was to be practised by the local population under the Forest Induna. About 300 square miles were burnt as soon as the grass would catch and no late fires were reported from this area.

105. In the Livingstone District the introduction of fire protection by the Native Authority was not so successful. Forty square miles of exploited forest in the Native Reserve were protected but had the work been undertaken departmentally it would probably have been less expensive. The scheme will be continued, however, in the hope that the costs will be reduced and efficiency increased.

106. 120 square miles of exploited and 26 square miles of unexploited forest were protected departmentally. A few minor fires occurred in the protected area but little damage was done. 40 square miles of the forest in which they are now operating were protected by the Zambesi Sawmills. Three serious fires occurred in this area and some 14 square miles of regeneration and pole growth were badly damaged. The cause of the most serious fire was investigated by the police and, although the persons responsible were traced, sufficient evidence for an action could not be obtained.

Shifting Cultivation.

107. On the poor soils of the Sesheke District agriculture is largely dependent on the fertility accumulated under forest growth. It was formerly common practice to clear new gardens in virgin forest every year—a wasteful process which obviously could not be continued indefinitely. Recently the Paramount Chief provisionally prohibited the making of gardens in virgin forest and the people were forced to turn to areas of secondary growth. As these areas are limited and their fertility is rapidly exhausted it would be both unfair and foolish to prohibit, unconditionally, the clearing of virgin forest. A new order was therefore issued permitting the clearing of forest in approved areas subject to the regeneration of the gardens under the Taungya system.

108. Demonstration Taungya plots were laid out in suitable areas and the scheme seems to have appealed to the native population. Taungya may not prove successful, it has only had a very moderate degree of success in the Livingstone District where rodents have done much damage to seeds and seedlings, but the control which can now be exercised over shifting cultivation makes it possible to confine gardens to the poorer forested areas and this alone will go a long way toward solving a serious problem without inflicting hardship.

Buildings and Roads.

109. In the past all travelling has been done on foot. The advantages of this were obvious while the country remained practically unknown, but now that reconnaissance is nearing completion adherence to this method of transport would be wasteful. Forest headquarters have been transferred from Bombwe, an island of sand surrounded by Mopane forest which is impassible to motor transport in the rains, to Situmpa forest on the Machili River. The new site is near the logging railhead at Mulobezi and 160 square miles of forest lie within easy access. The new headquarters can also be connected by all-weather motor road to the more distant Katimo-Molilo forests in the Sesheke district. A somewhat ambitious and most attractive double-storyed house has been built departmentally at a cost of £150, but it must be stated that much of the woodwork was kindly given by the Zambesi Sawmills or obtained from demolished houses in Livingstone. In addition, a permanent camp has been erected at Katimo-Molilo to serve as a base for the extensive forests in that region. A motor vanette has been provided.

110. Road making was carried out as rapidly as possible. Eighty miles were completed during the year and the line for a further 45 miles was cut. As far as possible the roads are being sited to serve as forest boundaries and fire guards. The lod extraction lines in Situmpa forest are being converted into motor roads.

DIVISIONAL OPERATIONS: NORTHERN DIVISION.

111. The management of the Crown Forests in the Copper Belt forms the chief work in this division. This tremendous task must be regarded more as an ideal to be aimed at rather than the main item of a programme, while the staff remains at its present level. Nevertheless substantial progress has been made towards the exercise of that closeness of control which is necessary if the main industry of the Territory is to be assured of a perpetual supply of native timbers. In addition, silvicultural experiments designed to provide data necessary for the formulation of working plans for the Copper Belt forests are in progress.

112. With the advice and assistance of the department, the Administration took strong measures during the year to check unauthorised and destructive squatting in Crown forests. This is being followed up by the demarcation of Forest Reserves near the principal centres of population.

Silviculture.—Natural Regeneration and Fire Protection.

113. The main general operation carried out in Forest Reserves was fire protection, particularly of areas under coppice regeneration after clear-felling for firewood. It is now evident that in the vicinity of any native settlement extensive areas can only be economically protected by early-burning. Following the cutting of the tree growth in open woodland, which covers most of the present fuel reserves, comes a thick grass growth through which the natural regeneration, preponderantly of coppice or sucker origin, appears able to force its way provided that it is not regularly burnt back by grass-fires. This grass-growth is very easy to ignite during the dry season and, although it has proved possible to guard against accidental fires and

prevent their entry from adjoining land, the past year has brought a number of cases of malicious firing within the protected areas themselves. It is impossible to exclude all natives from fuel reserves in the neighbourhood of townships and equally impossible at a reasonable cost to keep watch over everyone who enters. The only solution, therefore, is to extend early-burning over practically the whole of the areas on which regrowth is wanted.

114. The technique of early-burning still presents difficulties. In most uncut woodland the task is comparatively simple, except in some Northern types in which, as there is a very thin grass growth, firing is only possible after the forest floor has been covered by fallen leaves in late August or September. Elsewhere the grass dies off slowly and irregularly and early-burning can be carried out over a fairly lengthy period. But in felled areas, particularly in the Lusaka Reserves, a sudden cold wind in May or June is apt to kill off both the grass and the foliage on the young regrowth almost overnight. The result is that whereas one day only a very partial burn can be obtained, on the following day the whole of the grass may burn fiercely. The laying out of all firewood coupes in narrow strips, leaving equal belts of uncut woodland between, is being tried as a check against the sudden drying effect of these winds.

115. Where there is no demand for the smaller firewood sizes, the disposal of slash, which even under early-burning can cause a serious blaze, presents a further problem. A series of plots embodying different systems of stacking this slash has been laid out in Ndola West Forest Reserve as follows :

- (a) Stacking of branch-wood in parallel lines across the cutting area.
- (b) Scattering of branch-wood as widely and evenly as possible over the whole area.
- (c) Stacking of branch-wood in heaps sporadically over the area.

Each method has been duplicated, with one plot cut in the dry season and the other cut during the rains.

Improvement Fellings.

116. Although much of the Congo Border region is covered by various types of dense woodland, so many of the trees are defective in one way or another that the yield of useful timber is very low. Good straight trees, 9 inches and upwards in diameter, are needed in increasing quantities by the mines. An experiment has been made on a small scale in Ndola West Forest Reserve in improving the indigenous bush by means of "Improvement Fellings" so as to increase the ultimate yield of useful timber. Three plots, each of three acres, were first enumerated and then treated as follows :

- (a) A heavy improvement felling leaving only the best stems.
- (b) A light improvement felling directed only to relieve the best trees.
- (c) Control : Removal of exploitable trees only.

Periodical remeasurement of all the trees remaining in each plot will be carried out to compare the increment and yield under the different systems.

Artificial Regeneration and Planting.

117. *Khaya nyasica* has been deleted from the trials of indigenous species at Ndola as practically all the plants have been attacked by a stem borer. This pest also caused damage to *Entandrophragma* sp. and *Cedrela toona*. *Brachystegia hockii* has been added to the trials in place of *Khaya*. The sowings carried out last year in lines cleared through the natural vegetation were disappointing, even with some species which had done well in completely cleared ground. The ease with which the different species can be established, especially by spot sowings, has varied considerably from year to year, on account of the quality of the seed.

118. Of exotic species, Pines have received most attention. Previous plantings have been conspicuously unsuccessful, but the introduction of mycorrhiza-infected soil from Southern Rhodesia during the past year has resulted in a remarkable improvement in the quality of the plants raised in the nursery for planting at the end of the year.

119. The experiments in raising Pines in the high rainfall area at Mwinilunga were visited in October. The work has been efficiently supervised by Capt. K. R. Paterson during the last two years, but the results have shown, here as elsewhere, that there is a conspicuous lack of any natural mycorrhizal fungus in the soils of the Territory. Infected soil was provided and the extension of the trials will be delayed until a general spread of the fungus has been obtained in the nursery.

120. Fresh seed of *Maesopsis eminii* from Elisabethville gave a germination of over 70 per cent. after either being soaked in water or buried in a termite-nest for 10 days; untreated seed was slightly inferior, but the germination of seeds cracked before sowing was less than 20 per cent. Like the Pines, this species was more successfully established by clay-potted transplants than by open rooted plants.

Utilisation.

121. No practical work was carried out during 1936 beyond the annual inspection of the preservative and durability test against termite attack laid down in 1933. In this the relative durability of the species and the efficiency of the preservative solutions employed remains unchanged.

122. During his 2 months' course in South Africa, Mr. Duff made a study of the uses of timber in the Johannesburg gold mines. Particular attention was paid to the preservative treatment of mining timbers. Through the courtesy of the Forest Department of South Africa, much useful information relating both to timber seasoning and wood preservation was obtained from the Forest Products Institute at Pretoria.

Seed, Plants and Advisory Work.

123. Occasional issues of seeds and plants were made to the public, and advice on tree-planting was supplemented by personal inspection wherever possible.

124. Contact was maintained with all developments in utilisation on the Copper Belt. Particular mention may be made of the continued co-operation between the Forest Officers and the local sawmill at Ndola. This firm has always been willing to act on Forest Officers' advice on the handling of indigenous timber and its methods have steadily improved. The improved handling of the better quality woods has led to reduced losses during seasoning, and an increasing number of hitherto despised species have been utilised. Mining sleepers are also being cut from the lower quality timbers and rendered more durable by preservative treatment. In return, the practical experience of the firm has greatly helped the department in an understanding of the properties of native woods.

FOREST INDUSTRIES AND EXPLOITATION.

Milling.

125. The Zambesi Sawmills Ltd. worked at full capacity throughout the year, employing 95 Europeans and 3,700 natives in the mills and forests. 2,470,000 cubic feet of timber in the round were extracted from Yeta's forests and 470,000 cubic feet of timber were brought in from the Bechuanaland forests for milling in Livingstone. The actual sawn output was 1,281,000 cubic feet of timber made up as follows:

Railway and Mine Sleepers	...	1,016,000 cubic ft.
Mining and other timber	...	169,000 cubic ft.
Parquet and other flooring	...	95,000 cubic ft.

The output of sleepers represents an increase of 30 per cent. over the 1935 figures. The increase in the production of parquet and other flooring is still more remarkable as last year's output was only 5,500 cubic feet.

Mining Timbers.

126. The use of indigenous timber for mining purposes continued to expand during the year, partly on account of the general increase in mining activity and partly as the result of fuller realisation of the economies which could thereby be effected. No accurate figures of the amount of timber drawn from their own properties by the mining companies are available, but it is believed to be much in excess of a quarter of a million cubic feet. This timber consists mostly of large poles, which are required for the 'poleing' operation in the process of copper refining at Nkana, and of smaller poles, under 12 inches in diameter, which are generally used as splits, laggings and props. Large quantities of firewood are also consumed in small engine furnaces, in brick-burning and in the production of charcoal. All shaft timbers and sawn baulks are still imported.

127. An Ndola firm produced some 7,000 mine sleepers, principally of *Isobertia paniculata* and *Brachystegia hockii*, from Crown Land near Chondwe Siding. The sleepers were pit-sawn in the forest, and then cross-cut to size and impregnated with Arsenious Oxide in Ndola before being supplied to Nkana Mine, where they have superseded the roughly adzed product, fashioned on the mine's own property, which was used in the past. The total cut of this sleeper wood during the year was 26,000 cubic feet in the round.

128. A Belgian contractor working at Kapako near the Congo Border cut 41,000 cubic feet of timber and approximately 900 cords of firewood for export to Kipushi Mine. The timber consisted for the most part of small poles, 7 inches to 9 inches in diameter. This cutting slackened off at the end of the year as an underground fire restricted mining operations at Kipushi.

Furniture and Joinery.

129. Commercial building construction on the Copper Belt has maintained the demand for joinery and furniture timbers. *Pterocarpus angolensis* is naturally the favourite species, but *Erythrophloeum africanum*, *Afzelia quanzensis*, and *Albizzia antunesiana* are also prized, while *Brachystegia hockii* in particular found more extensive use during the year as a joinery timber. A previously unused species, *Anthocleista zambesiaca* was worked experimentally, but it is doubtful whether it will maintain its promise as a carpentry wood.

Firewood.

130. Domestic firewood is probably the largest single item in the total wood consumption of the Territory, but it is only around townships that the demand tends to exceed the easily available supplies. A policy of establishing Fuel Reserves at these places has been followed, but a considerable proportion of the present requirements is still drawn from private land. At Lusaka regular sales of firewood were made from the Forest Reserves, but the total cut is at present much below the annual increment. After some difficulties over cutting conditions, another large scale firewood licence was issued to Broken Hill Mine to cut 2,500 cords. This mine, which has already exhausted 30 square miles of the forest on its own holdings, has recently purchased all the timber over some 10 square miles of private land adjoining its property, and this is likely to lessen the demand for wood from Crown Land. Sales of firewood from the local reserve at Ndola became brisker at the end of the year, but were still only a small fraction of the total consumption of the town. A licence was issued to cut 5,500 cords of firewood over a period of 2 years to Misundu Lime Works near Ndola.

EXPORTS AND IMPORTS.

131. The following tables show the value (in country of origin) of exports and imports of timber during recent years. It will be noted that the heavy adverse trade balance of 1930 and 1931 has been reversed during the last two years. This is due to the fact that the local milling industry has made tremendous strides in recent years and to an equally spectacular decline in the value of imports. The latter is due in part to the completion of major construction programmes at the Mines and in part to the increasing use of indigenous timbers for mining purposes. The chief imported timber is Pitch Pine which is used for mine shafts.

		EXPORTS.						
		1930	1931	1932	1933	1934	1935	1936
		£	£	£	£	£	£	£
Unmanufactured	...	4,077	4,236	9,674	11,634	20,903	25,964	
Partly manufactured	...	1,383	178	73	309	1,245	2,247	
Joinery	...	553	91	514	347	79	138	Details
Furniture	...	3,299	4,248	9,256	6,222	1,039	428	not
Other manufactures	...	14,113	26,993	3,858	4,538	1,351	1,677	avail-
Railway Sleepers	...	*	*	17,826	31,291	39,557	74,476	able.
<i>Totals</i>	...	23,425	35,746	41,201	54,341	64,174	104,930	142,950
* Included under "Other manufactures."								
		IMPORTS.						
		1930	1931	1932	1933	1934	1935	1936
		£	£	£	£	£	£	£
Unmanufactured	...	98,183	58,502	29,293	29,264	41,294	24,392	
Partly manufactured	...	12,767	10,361	2,304	26,46	2,754	2,666	Details
Furniture	...	44,988	43,181	9,527	8,375	12,867	9,642	not
Joinery	...	33,562	27,277	4,232	1,867	4,202	4,167	avail-
Other manufactures	...	18,927	12,464	6,137	5,940	10,632	4,492	able.
		208,427	151,785	51,493	48,092	71,149	45,359	53,927

REVENUE AND EXPENDITURE.

132. Revenue and expenditure since the inception of the Forest Service is given in the following table :

Year				Gross Revenue	Expenditure *
				£	£
1928-29	...	...	...	2,458	641
1929-30	...	...	...	3,757	1,376
1930-31	...	...	...	850	1,854
1931-32	...	...	...	417	2,740
1932-33	...	...	...	423	2,997
1933 (9 months)	...	...	...	316	2,366
1934	...	...	...	693	2,298
1935	...	...	...	1,040	3,540
1936 (estimated)	...	...	...	1,400+1,035	3,100+1,035

* No share of the cost of administrative headquarters of the joint departments is included in the table of expenditure.

133. These figures require some explanation. On the revenue side the sudden decline in 1931 was due to the exhaustion of the *Baikiaea* Crown forests by the Zambesi Sawmills. Exploitation was then transferred to 'Yeta's forests' from which no revenue accrues to Government. The subsequent slight recovery in revenue figures is due more to the success of the police work of the Forestry staff than to an increase in consumption. Increase in consumption has occurred but it has largely been confined to timber obtained by the Mines from their own properties and 'special grants' and is therefore not reflected in revenue figures.

134. The item of £1,035 in the 1936 expenditure represents the cost of operations in the Sesheke forests financed by an advance from the Treasury. This is offset on the revenue side by an equivalent sum which will ultimately be recovered from the Barotse Forest Fund.

MAZABUKA,
13th April, 1937.

C. J. LEWIN,
Director of Agriculture.

